Designation: D6185 – 10

Standard Practice for Evaluating Compatibility of Binary Mixtures of Lubricating Greases[1]

1. Scope

1.1 This practice covers a protocol for evaluating the compatibility of one or three binary mixtures of lubricating greases by comparing their properties or performance relative to those of the neat greases comprising the mixture.

1.2 Three properties are evaluated in a primary testing protocol using standard test methods: (*1*) dropping point by Test Method D566 (or Test Method D2265); (*2*) shear stability by Test Methods D217, 100 000–stroke worked penetration; and (*3*) storage stability at elevated-temperature by change in 60-stroke penetration (Test Method D217). For compatible mixtures (those passing all primary testing), a secondary (nonmandatory) testing scheme is suggested when circumstances indicate the need for additional testing.

1.3 Sequential or concurrent testing is continued until the first failure. If any mixture fails any of the primary tests, the greases are incompatible. If all mixtures pass the three primary tests, the greases are considered compatible.

1.4 This practice applies only to lubricating greases having characteristics suitable for evaluation by the suggested test methods. If the scope of a specific test method limits testing to those greases within a specified range of properties, greases outside that range cannot be tested for compatibility by that test method. An exception to this would be when the tested property of the neat, constituent greases is within the specified range, but the tested property of a mixture is outside the range because of incompatibility.

1.5 This practice does not purport to cover all test methods that could be employed.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *This standard does not purport to address all the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and practices and determine the applicability of regulatory limitations prior to use.* For specific safety information, see 7.2.3.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D217 Test Methods for Cone Penetration of Lubricating Grease

D566 Test Method for Dropping Point of Lubricating Grease

D972 Test Method for Evaporation Loss of Lubricating Greases and Oils

D1092 Test Method for Measuring Apparent Viscosity of Lubricating Greases

D1263 Test Method for Leakage Tendencies of Automotive Wheel Bearing Greases[3]

D1264 Test Method for Determining the Water Washout Characteristics of Lubricating Greases

D1403 Test Methods for Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment

D1478 Test Method for Low-Temperature Torque of Ball Bearing Grease

D1742 Test Method for Oil Separation from Lubricating Grease During Storage

D1743 Test Method for Determining Corrosion Preventive Properties of Lubricating Greases

D1831 Test Method for Roll Stability of Lubricating Grease

D2265 Test Method for Dropping Point of Lubricating Grease Over Wide Temperature Range

D2266 Test Method for Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)

D2509 Test Method for Measurement of Load-Carrying Capacity of Lubricating Grease (Timken Method)

D2595 Test Method for Evaporation Loss of Lubricating Greases Over Wide-Temperature Range

D2596 Test Method for Measurement of Extreme-Pressure Properties of Lubricating Grease (Four-Ball Method)

D3336 Test Method for Life of Lubricating Greases in Ball Bearings at Elevated Temperatures

[1] This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.G0.01 on Chemical and General Laboratory Tests.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Withdrawn. The last approved version of this historical standard is referenced on www.astm.org.

D3337 Test Method for Determining Life and Torque of Lubricating Greases in Small Ball Bearings[3]
D3527 Test Method for Life Performance of Automotive Wheel Bearing Grease
D4049 Test Method for Determining the Resistance of Lubricating Grease to Water Spray
D4170 Test Method for Fretting Wear Protection by Lubricating Greases
D4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants
D4290 Test Method for Determining the Leakage Tendencies of Automotive Wheel Bearing Grease Under Accelerated Conditions
D4425 Test Method for Oil Separation from Lubricating Grease by Centrifuging (Koppers Method)
D4693 Test Method for Low-Temperature Torque of Grease-Lubricated Wheel Bearings
D4950 Classification and Specification for Automotive Service Greases
D5706 Test Method for Determining Extreme Pressure Properties of Lubricating Greases Using a High-Frequency, Linear-Oscillation (SRV) Test Machine
D5707 Test Method for Measuring Friction and Wear Properties of Lubricating Grease Using a High-Frequency, Linear-Oscillation (SRV) Test Machine

2.2 *Federal Standard:*
Federal Test Method 3467.1 (Standard 791C), Storage Stability of Lubricating Grease[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *bleed (bleeding)*, *n—of lubricating greases,* the separation of a liquid lubricant from a lubricating grease for any cause.

3.1.2 *lubricant*, *n*—any material interposed between two surfaces that reduces the friction or wear between them. **D4175**

3.1.3 *lubricating grease*, *n*—a semifluid to solid product of a dispersion of a thickener in a liquid lubricant.

3.1.3.1 *Discussion*—The dispersion of the thickener forms a two-phase system and immobilizes the liquid lubricant by surface tension and other physical forces. Other ingredients imparting special properties are often included. **D217**

3.1.4 *spatulate*, *v*—to mix or blend by spreading and folding with a flat thin, usually metal, tool.

3.1.5 *syneresis*, *n—of lubricating greases*, the separation of liquid lubricant from a lubricating grease due to shrinkage or rearrangement of the structure.

3.1.5.1 *Discussion*—Syneresis is a form of bleeding caused by physical or chemical changes of the thickness. Separation of free oil or the formation of cracks that occur in lubricating greases during storage in containers is most often due to syneresis.

3.1.6 *thickener*, *n—in a lubricating grease,* a substance composed of finely divided particles dispersed in a liquid lubricant to form the product's structure.

3.1.6.1 *Discussion*—The thickener can be fibers (such as various metallic soaps) or plates or spheres (such as certain non-stop thickeners) which are insoluble or, at most, only very slightly soluble in the liquid lubricant. The general requirements are that the solid particles be extremely small, uniformly dispersed, and capable of forming a relatively stable, gel-like structure with the liquid lubricant. **D217**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *compatibility*, *n— of lubricating greases*, the characteristic of lubricating greases to be mixed together without significant degradation of properties or performance.

3.2.1.1 *Discussion*—When a mixture of two greases has properties or performance significantly inferior to both of the neat, constituent greases, then the two greases are incompatible. If the properties are inferior to those of one neat grease but not inferior to those of the other, then such is not necessarily considered an indication of incompatibility. To be considered significantly inferior, the property of the mixture would be worse than the poorer of the two neat greases by an amount exceeding the repeatability of the test method used to evaluate the property (see *pass* and *fail*). Incompatibility most often is manifested by a degradation in physical properties rather than in chemical properties, although, occurrence of the latter is not unknown.

3.2.2 *borderline compatibility*, *n—of lubricating greases*, the characteristic of lubricating greases to be mixed together with only slight degradation of properties or performance.

3.2.2.1 *Discussion*—*Slight degradation* means that the properties or performance of the mixture is poorer than those of the two neat greases but by an amount less than the repeatability of the test method used to evaluate the property. (See *borderline pass*.)

3.2.3 *primary compatibility tests*, *n—of lubricating greases,* those test methods employed first to evaluate compatibility.

3.2.3.1 *Discussion*—The test methods considered the most significant in the evaluation of grease compatibility, insofar as they provide the most information with the least expenditure of testing resources, include tests for dropping point, consistency (usually softening) after shearing conditions, and consistency change after storage at elevated temperatures.

3.2.4 *secondary compatibility tests*, *n—of lubricating greases,* those test methods used to evaluate compatibility when the primary compatibility tests are insufficient or inconclusive.

3.2.4.1 *Discussion*—Such tests are driven by the critical features of a given application. For example, if the application subjects the grease to water contamination, water washout or water spray-off tests and, perhaps, corrosion tests would be used for additional evaluation. Secondary compatibility tests are suggested, but not required, by this practice.

3.2.5 *pass*, *n—in compatibility testing of grease mixtures,* a test result that is equal to or better than that of the poorer of the two constituent greases.

3.2.6 *borderline pass*, *n— in compatibility testing of grease mixtures,* a test result that is inferior to that of the poorer of the two constituent greases by an amount not exceeding the repeatability of the test method used for the evaluation.

[4] Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111–5094, Attn: NPODS.

3.2.6.1 *Discussion*—*Borderline pass, borderline fail, borderline compatible,* and *borderline incompatible* are synonymous terms.

3.2.7 *fail*, *n*—*in compatibility testing of grease mixtures,* a test result that is inferior to that of the poorer of the two constituent greases by an amount exceeding the repeatability of the test method used for the evaluation.

3.2.8 *50:50 mixture*, *n*—a uniform blend of 50 mass % of each of two component greases.

3.2.9 *10:90 mixture*, *n*—a uniform blend of 10 mass % of one grease with 90 mass % of a second grease.

3.2.10 *90:10 mixture*, *n*—a uniform blend of 90 mass % of one grease with 10 mass % of a second grease.

4. Summary of Practice

4.1 *Option 1*—A 50:50 mixture of two greases to be evaluated for compatibility is prepared by spatulating. This mixture and the two neat, constituent greases are tested using the primary compatibility tests (dropping point, 100 000-stroke worked penetration, and change in 60-stroke penetration due to high-temperature storage). Depending on the performance of the mixture, relative to those of the constituent greases, 10:90 and 90:10 mixtures may need to be tested in addition. Alternatively, Option 2 can be used. Instead of testing mixtures in sequential order, 10:90 and 90:10 mixtures are tested at the same time the 50:50 mixture is evaluated. If all mixtures pass the primary compatibility tests, or if the application requires the evaluation of specific properties, secondary compatibility tests can be employed for further evaluation. Such tests can be run concurrently, if desired.

5. Significance and Use

5.1 The compatibility of greases can be important for users of grease-lubricated equipment. It is well known that the mixing of two greases can produce a substance markedly inferior to either of its constituent materials. One or more of the following can occur. A mixture of incompatible greases most often softens, sometimes excessively. Occasionally, it can harden. In extreme cases, the thickener and liquid lubricant will completely separate. Bleeding can be so severe that the mixed grease will run out of an operating bearing. Excessive syneresis can occur, forming pools of liquid lubricant separated from the grease. Dropping points can be reduced to the extent that grease or separated oil runs out of bearings at elevated operating temperatures. Such events can lead to catastrophic lubrication failures.

5.1.1 Because of such occurrences, equipment manufacturers recommend completely cleaning the grease from equipment before installing a different grease. Service recommendations for grease-lubricated equipment frequently specify the caveat–*do not mix greases under any circumstances.* Despite this admonition, grease mixing will occur and, at times, cannot be avoided. In such instances, it would be useful to know whether the mixing of two greases could lead to inadequate lubrication with disastrous consequences. Equipment users most often do not have the resources to evaluate grease compatibility and must rely on their suppliers. Mixing of greases is a highly imprudent practice. Grease and equipment manufacturers alike recognize such practices will occur despite all warnings to the contrary. Thus, both users and suppliers have a need to know the compatibility characteristics of the greases in question.

5.2 There are two approaches to evaluating the compatibility of grease mixtures. One is to determine whether such mixtures meet the same specification requirements as the constituent components. This approach is not addressed by this practice. Instead, this practice takes a specification-independent approach; it describes the evaluation of compatibility on a relative basis using specific test methods.

5.2.1 Three test methods are used because fewer are not sufficiently definitive. For example, in one study, using 100 000-stroke worked penetration for evaluation, 62 % of the mixtures were judged to be compatible.[5] In a high-temperature storage stability study, covering a broader spectrum of grease types, only one-third of the mixtures were compatible.[5] These studies used different criteria to judge compatibility.

5.2.2 Compatibility cannot be predicted with certainty from foreknowledge of grease composition. Generally, greases having the same or similar thickener types will be compatible. Uncommonly, even greases of the same type, although normally compatible when mixed, can be incompatible because of incompatible additive treatments. Thus, compatibility needs to be judged on a case-by-case basis.

5.3 Two constituent greases are blended in specific ratios. A 50:50 mixture simulates a ratio that might be experienced when one grease (Grease A) is installed in a bearing containing a previously installed, different grease (Grease B), and no attempt is made to flush out Grease B with Grease A. The 10:90 and 90:10 ratios are intended to simulate ratios that might occur when attempts are made to flush out Grease B with Grease A.

NOTE 1—Some companies evaluate 25:75 and 75:25 ratio mixtures instead of 10:90 and 90:10 ratio mixtures. But, the latter two ratios, which are prescribed by this practice, are considered more representative of the flushing practice described in 5.3.

5.3.1 Incompatibility is most often revealed by the evaluation of 50:50 mixtures. However, in some instances 50:50 mixtures are compatible and more dilute ratios are incompatible. (See Appendix X1 and Meade.[6])

5.4 Compatibility information can be used in product information literature supplied with specific greases. It can be used also in literature describing lubrication practices and equipment maintenance.

6. Apparatus

6.1 The equipment and materials required for this practice shall be those required by the test methods used to evaluate compatibility. At the least, this will include those required by the primary compatibility Test Methods D217 and D566 (or D2265) and a laboratory oven.

6.1.1 *Dropping Point Equipment*, grease cup, test tube, thermometer, temperature bath, and accessories as described in

[5] Myers, E. H., "Incompatibility of Greases," *NLGI Spokesman*, April 1983, p. 24.

[6] Meade, F. S., "Compatibility of Greases," *Rock Island Arsenal Laboratory Report*, No. 56-2405, PB 121731, Aug. 20, 1956.